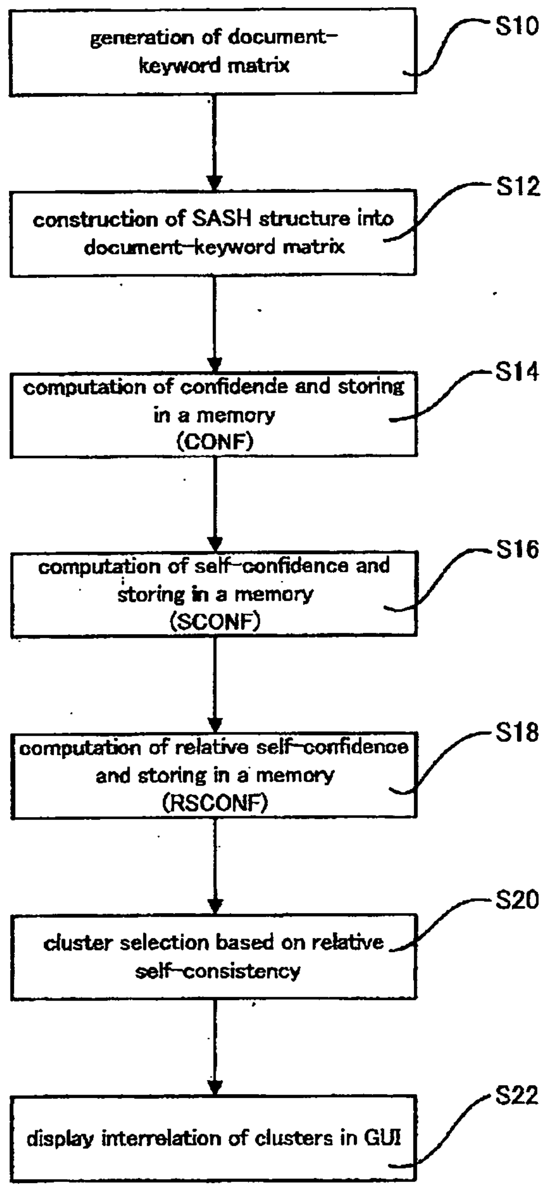
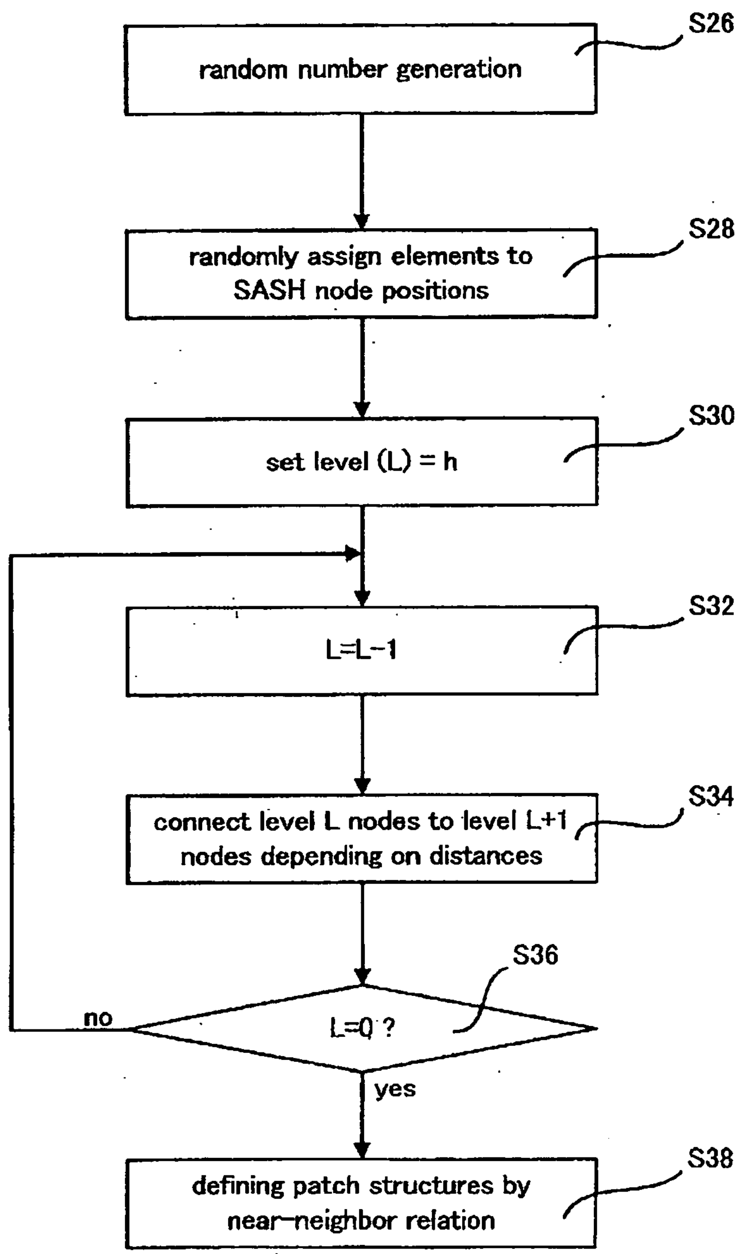

generation of document-keyword matrix
S10
construction of SASH structure into document-keyword matrix
S12
computation of confidende and storing in a memory (CONF)
S14
computation of self-confidence and storing in a memory (SCONF)
S16
computation of relative self-confidence and storing in a memory (RSCONF)
S18
cluster selection based on relative self-consistency
S20
display interrelation of clusters in GUI
S22

FIG 1



random number generation
S26
randomly assign elements to SASH node positions
S28
set level (L) = h
S30
L=L-1
S32
connect level L nodes to level L+1 nodes depending on distances
S34
L=0 ?
S36
no
yes
defining patch structures by near-neighbor relation
S38

FIG 2

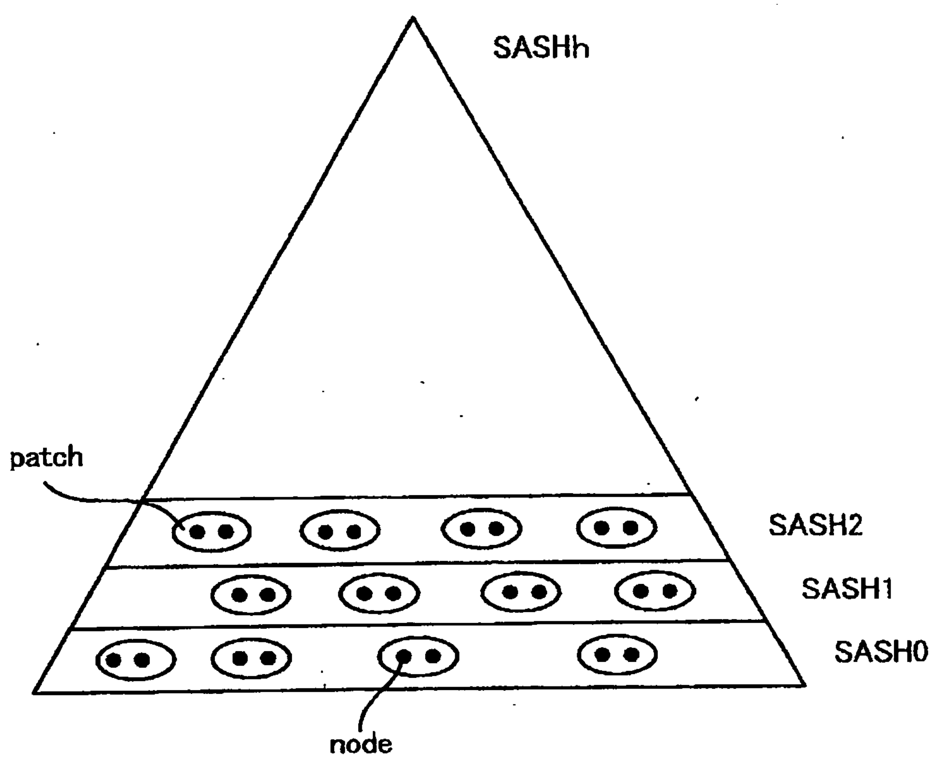


FIG 3

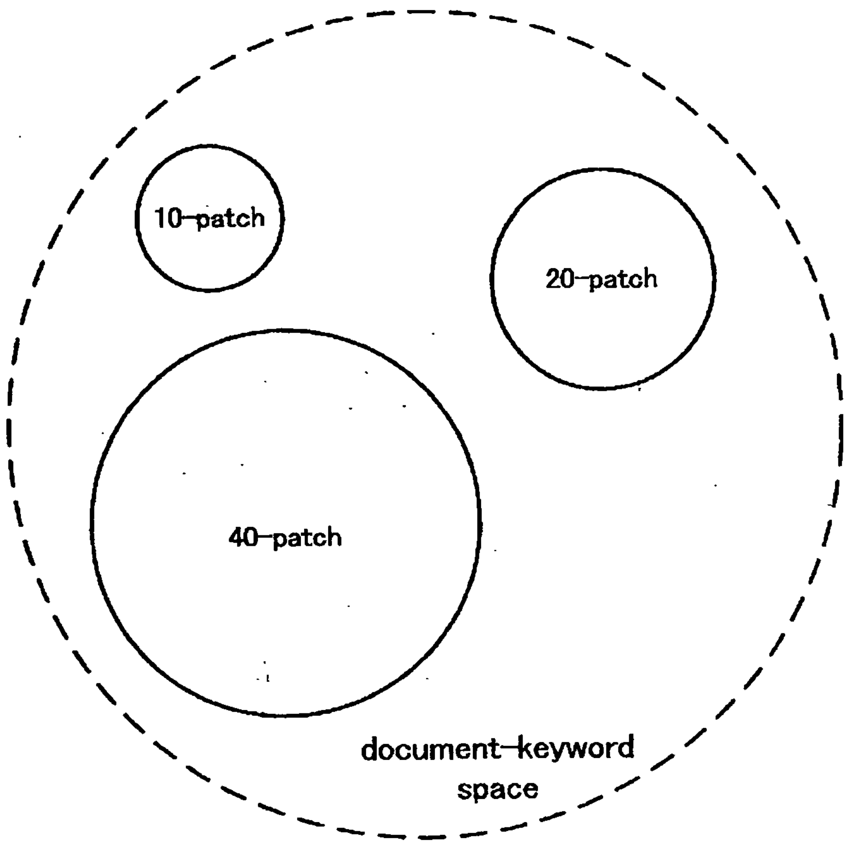
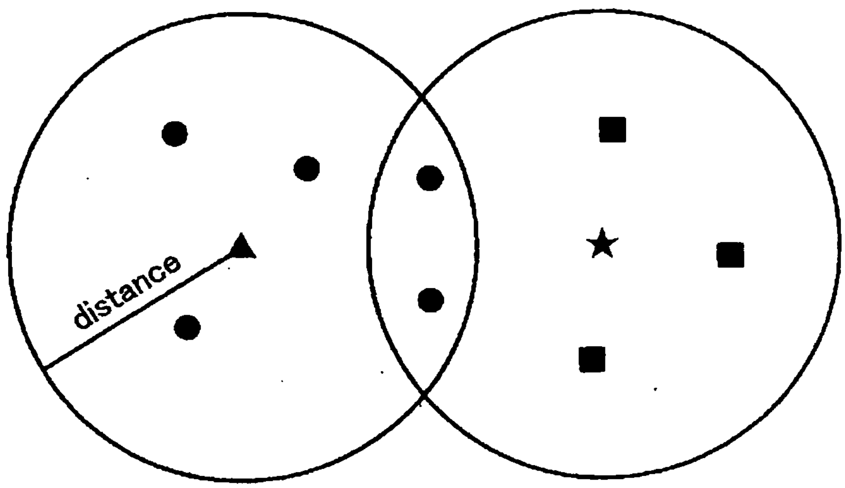


FIG 4



Patch C_i Patch C_j

$\mathrm{CONF}(C_i, C_j) = 2/5 = 40\%$

FIG 5

```
Profile (query q; maximum patch size m): SCONF list SCONFL
    {Let QNL be the m-patch precomputed for query q.}
    {Let NNL be a list of the m-patches precomputed for every element of QNL.}
    {Initially, w.count = ∅ is assumed for every element v in the data set.}
1.  score ← 0;
    {Initially, no query neighbors are in the current patch.}
    for i = 1 to m do
2.      QNL[i].count ← 0;
    end for
    for i = 1 to m do
        {Retrieve the number of times QNL[i] has been encountered as an external neighbor so far.}
3.      score ← score + QNL[i].count;
        {Indicate that henceforth QNL[i] is in the current i-patch.}
4.      QNL[i].count ← present;
        for j = 1 to i − 1 do
5.          w ← NNL[j, i];
            if w.count = present then
6.              score ← score + 1;
            else if w.count ≥ 0 then
7.              w.count ← w.count + 1;
            end if
8.          w ← NNL[i, j];
            if w.count = present then
9.              score ← score + 1;
            else if w.count ≥ 0 then
10.             w.count ← w.count + 1;
            end if
        end for
11.     w ← NNL[i, i];
        if w.count = present then
12.         score ← score + 1;
        else if w.count ≥ 0 then
13.         w.count ← w.count + 1;
        end if
14.     SCONFL[i] = score/i²;
    end for
    {Reset the counts to their default value.}
    for i = 1 to m do
15.     QNL[i].count ← ∅;
    end for
```

FIG 6

SASH #	patch list	CONFL	SCONFL	RSCONFL
0	$NN(R_{1',0,0}, m)$, ⋯	⋯	⋯	⋯
1	$NN(R_{1',1,0}, m)$, ⋯	⋯	⋯	⋯
⋮	⋮	⋮	⋮	⋮
h	$NN(R_{1',0,0}, m)$, ⋯	⋯	⋯	⋯

FIG 7

```
RefineProfile (query q;
               inner patch size k_I;
               outer patch size k_O): reordered query k_I-patch RQNL
   {Let QNL be the k_O-patch precomputed for query q.}
   {Let NNL be a list of the k_O-patches precomputed for every element of QNL.}
   {Initially, v.inpatch = false is assumed for every element v in the data set.}
   {Identify the inner patch members.}
   for i = 1 to k_I do
1.    QNL[i].inpatch ← true;
   end for
   {Initialize the confidence value CONFc of every patch element to zero.}
   for i = 1 to k_O do
2.    CONFc[i] ← 0;
   end for
   {For each element of the outer patch, count the number of elements
      of their k-nearest-neighbor sets shared with that of q.}
   for i = 1 to k_O do
      for j = 1 to k_I do
3.       w ← NNL[i, j];
         if w.inpatch = true then
4.          CONFc[i] ← CONFc[i] + 1;
         end if
      end for
5.    CONFc[i] ← CONFc[i]/k_O;
   end for
   {Reorder the outer patch elements according to their confidence values, from highest to lowest.}
6. RQNL ← sort(QNL, CONFc, k_O);
   {Reset the patch membership indicators to their default values.}
   for i = 1 to k_I do
7.    QNL[i].inpatch ← false;
   end for
```

FIG 8

PatchCluster (data set S;
RSCM parameters a, b, $m = \varphi(b)$;
Thresholds α, β, γ, δ): query cluster graph G

1. Randomly partition the set S into subsets S_t of approximate size $\frac{|S|}{2^t}$, for $0 \leq t \leq h = \lfloor \log_2 |S| \rfloor$.
2. For all $0 \leq t \leq h$ do:
   (a) For every element $v \in S_t$, compute nearest-neighbor patches $\mathbf{NN}(R_t, v, m)$, where $R_t = \bigcup_{i \geq t} S_i$.
   (b) For each element $v_{t,i} \in S_t$, compute the optimal query cluster size $k(v_{t,i})$ maximizing $\mathbf{RSCONF}(\mathbf{NN}(R_t, v_{t,i}, k), \varphi)$, for values of k between a and b
   The ranked collection of patches
   $$C_t = \langle C_{t,i} \mid i < j \Rightarrow \mathbf{RSCONF}(C_{t,i}, \varphi) \geq \mathbf{RSCONF}(C_{t,j}, \varphi) \rangle$$
   form the candidates for the query clusters associated with sample $R_t \subseteq S$, where $C_{t,i} = \mathbf{NN}(R_t, v_{t,i}, k(v_{t,i}))$ and $C_{t,j} = \mathbf{NN}(R_t, v_{t,j}, k(v_{t,j}))$.
   (c) Let Q_t be a list of patches of C_t that have been confirmed as query clusters of R_t. Initially, Q_t is empty.
   (d) For all $1 \leq i \leq |C_t|$ do:
      i. If $\mathbf{RSCONF}(C_{t,i}, \varphi) < \alpha$, then break from the loop.
      ii. For all $w \in C_{t,i}$ do: if $\mathbf{NN}(R_t, w, k) \notin |C_t|$ for any value of k, or failing that, if $\max\{\mathbf{CONF}(\mathbf{NN}(R_t, w, k), C_{t,i}), \mathbf{CONF}(C_{t,i}, \mathbf{NN}(R_t, w, k))\} < \beta$, then add $C_{t,i}$ to the list Q_t.
3. Let h' be the largest index for which $|Q_{h'}| > 0$. Let $\{C_{t,j}\}$ be the set of patches comprising Q_t, where $C_{t,j} = \mathbf{NN}(R_t, q_{t,j}, k(q_{t,j}))\}$, for all $0 \leq t \leq h'$. Initialize the node set of the query cluster graph G to contain these patches, one patch per node.
4. For all $\delta \leq t \leq h'$, all $1 \leq j \leq |Q_t|$, and all $\max\{0, t-\delta\} \leq s \leq t$, do:
   (a) Compute $C'_{t,j} = \mathbf{NN}(R_s, q_{t,j}, 2^{t-s}k(q_{t,j}))\}$.
   (b) For all $1 \leq i \leq |Q_s|$, if $C_{s,i} \neq C'_{t,j}$ and $\max\{\mathbf{CONF}(C_{s,i}, C'_{t,j}), \mathbf{CONF}(C'_{t,j}, C_{s,i})\} \geq \gamma$, then introduce the edges $(C_{s,i}, C_{t,j})$ and $(C_{t,j}, C_{s,i})$ into G, with weights $\mathbf{CONF}(C_{s,i}, C'_{t,j})$ and $\mathbf{CONF}(C'_{t,j}, C_{s,i})$, respectively.

FIG 9

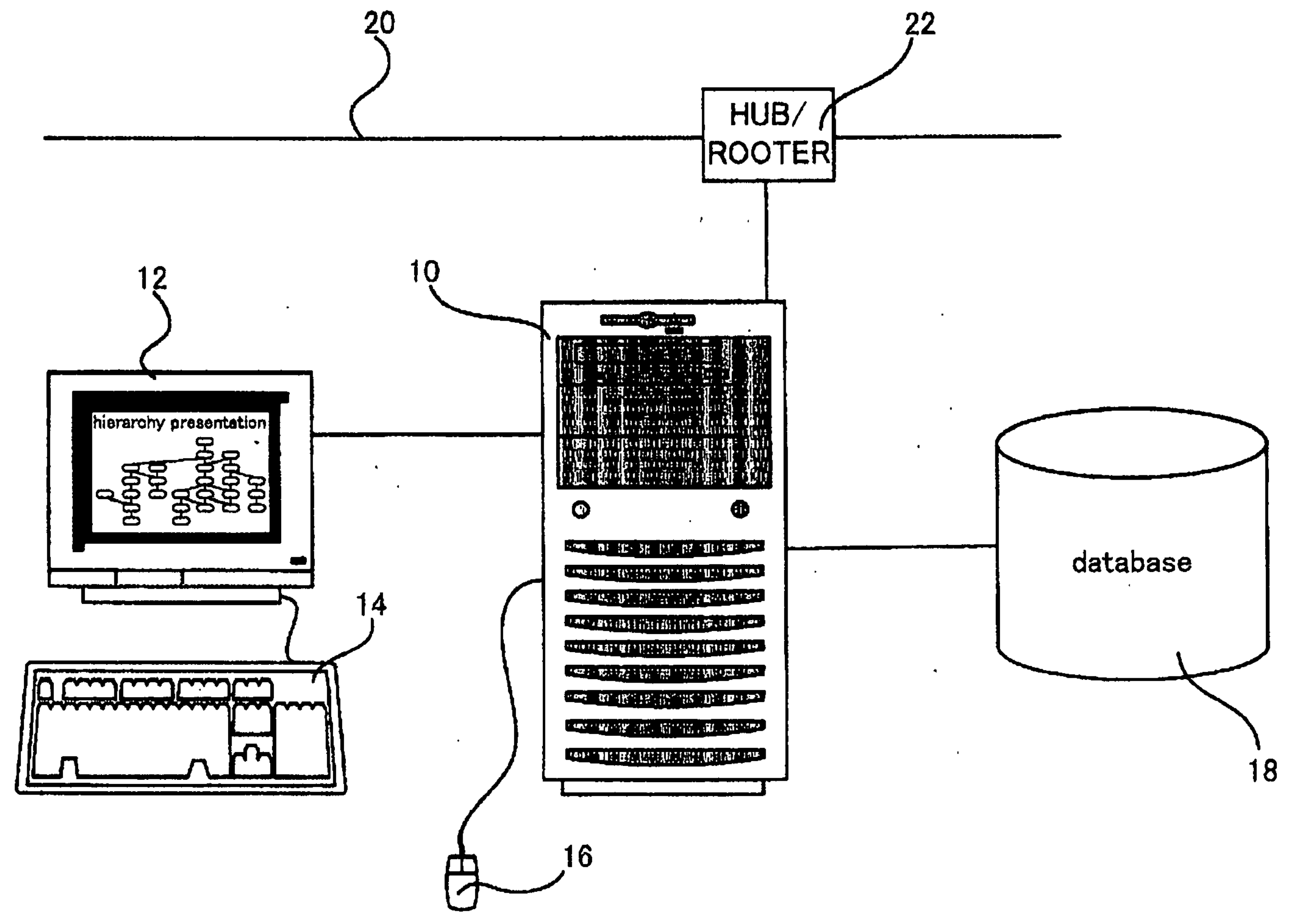

20
22
HUB/
ROOTER
12
10
hierarchy presentation
database
14
18
16

FIG 10

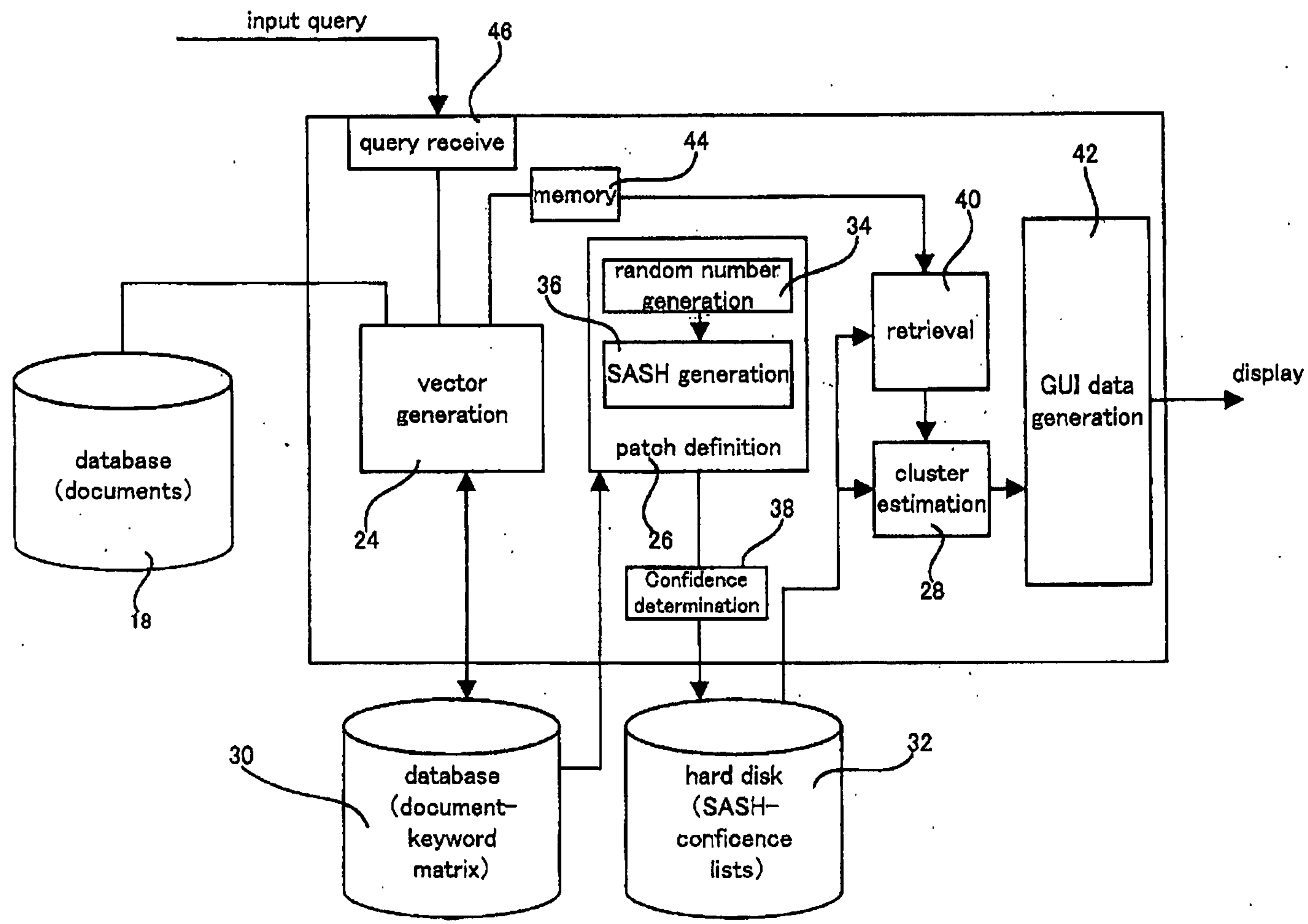

input query
46
query receive
44
memory
42
40
34
random number generation
36
SASH generation
retrieval
vector generation
GUI data generation
display
database (documents)
patch definition
cluster estimation
24
26
38
28
Confidence determination
18
30
database (document-keyword matrix)
hard disk (SASH-conficence lists)
32

FIG 11

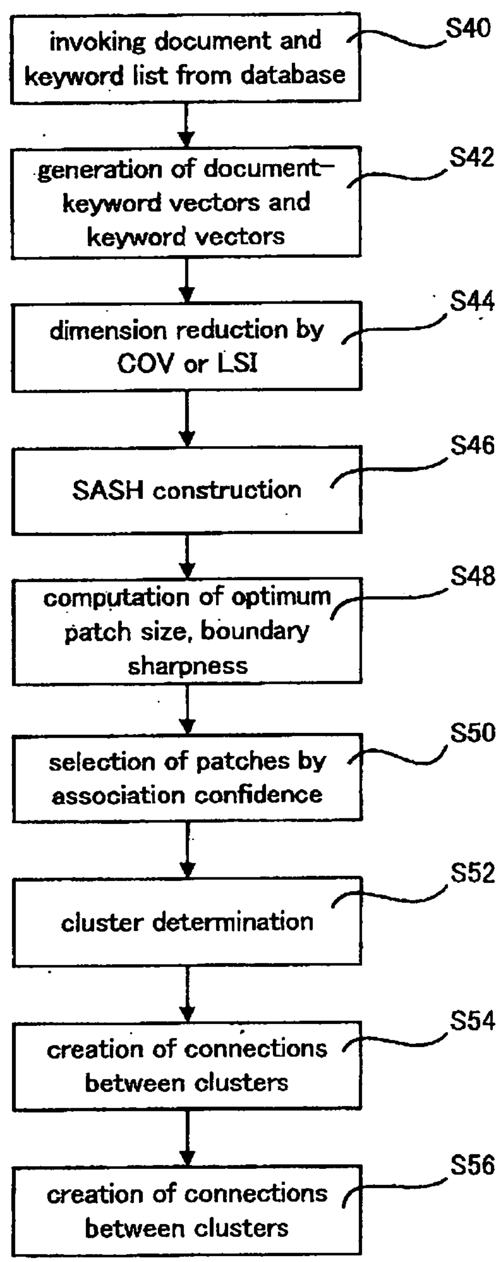
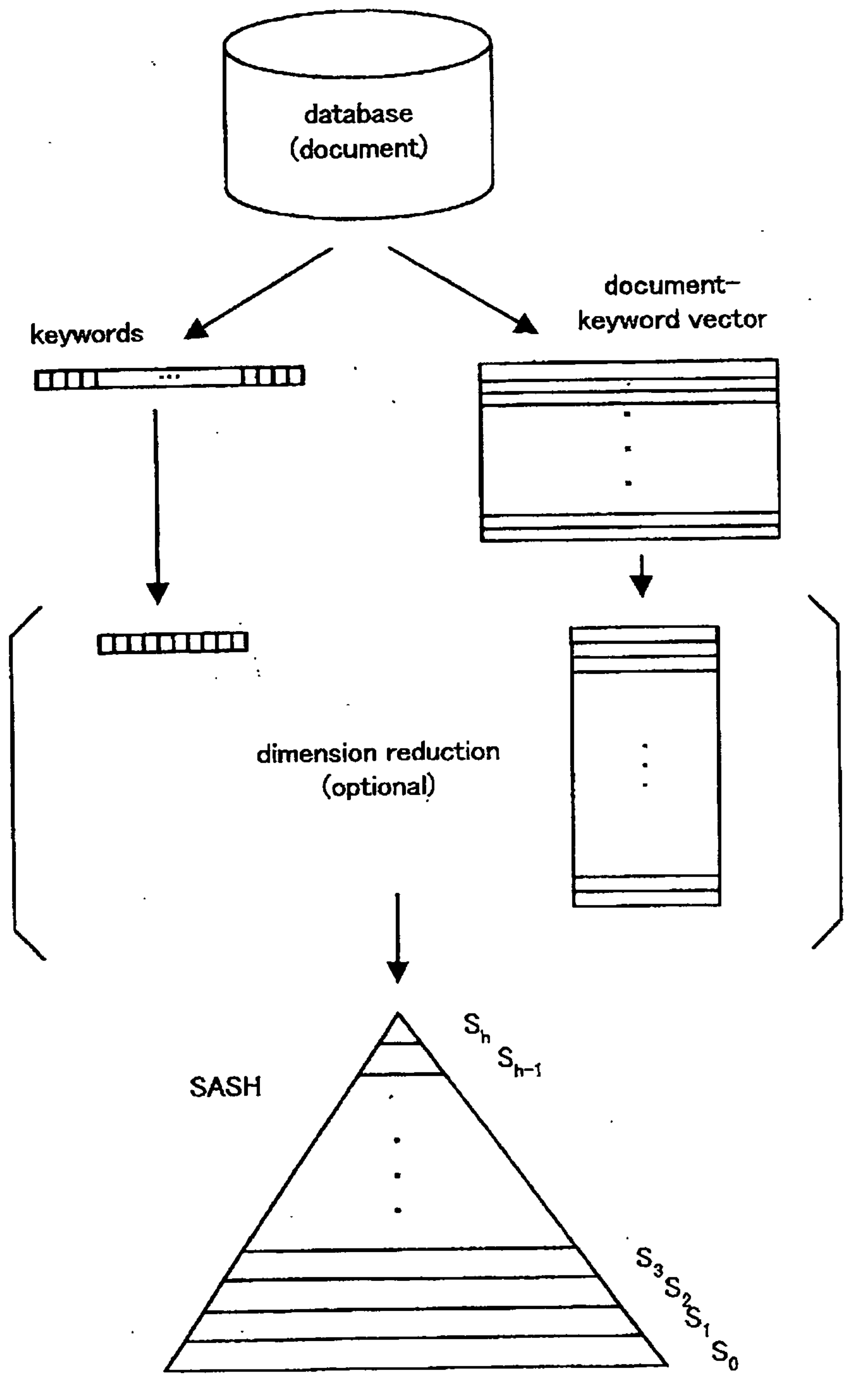

invoking document and keyword list from database
S40
generation of document-keyword vectors and keyword vectors
S42
dimension reduction by COV or LSI
S44
SASH construction
S46
computation of optimum patch size, boundary sharpness
S48
selection of patches by association confidence
S50
cluster determination
S52
creation of connections between clusters
S54
creation of connections between clusters
S56

FIG 12



database
(document)
keywords
document-
keyword vector
dimension reduction
(optional)
SASH
S_h
S_{h-1}
S_3
S_2
S_1
S_0

FIG13

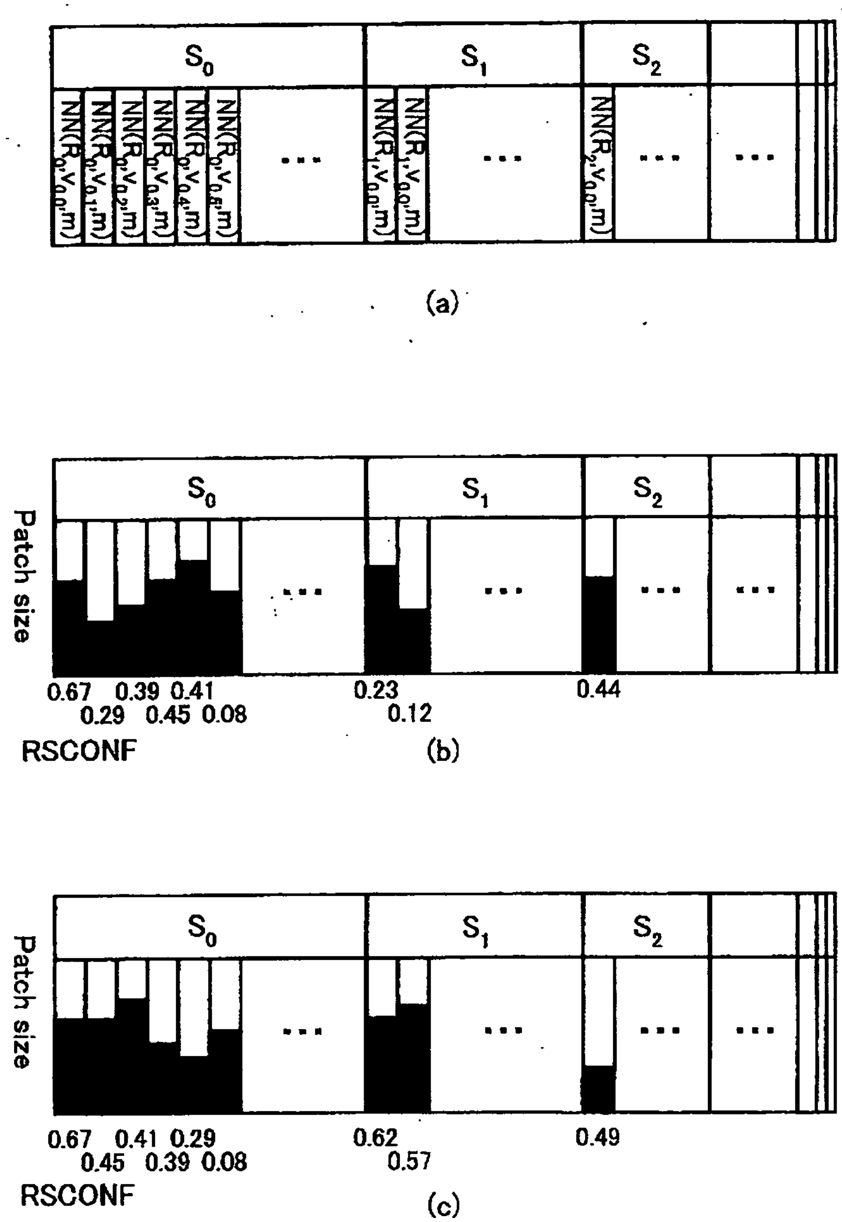
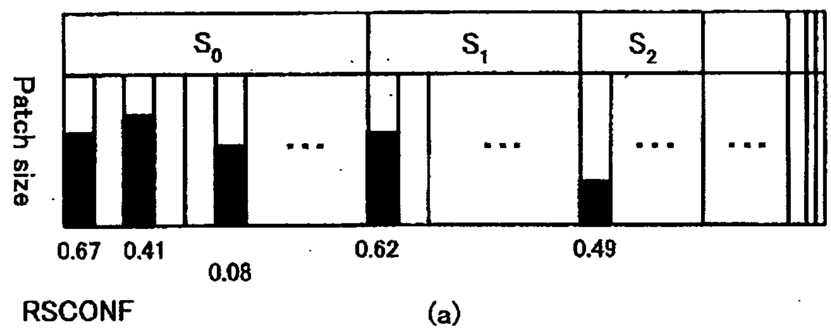
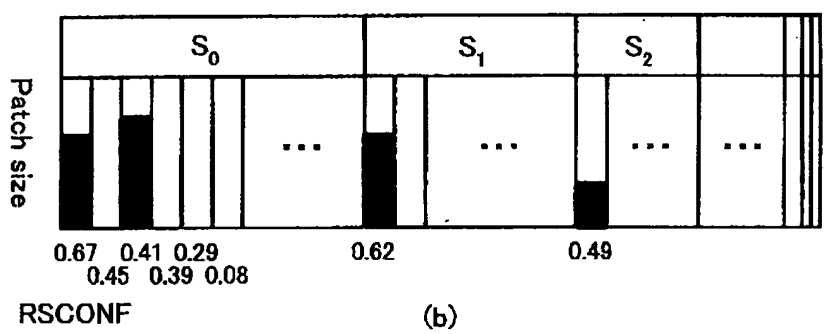

S0
S1
S2
NN(R0,V0,0,m)
NN(R0,V0,1,m)
NN(R0,V0,2,m)
NN(R0,V0,3,m)
NN(R0,V0,4,m)
NN(R0,V0,5,m)
NN(R1,V0,0,m)
NN(R1,V0,0,m)
NN(R2,V0,0,m)
(a)
Patch size
0.67 0.39 0.41
0.29 0.45 0.08
0.23
0.12
0.44
RSCONF
(b)
Patch size
0.67 0.41 0.29
0.45 0.39 0.08
0.62
0.57
0.49
RSCONF
(c)

FIG 14



(a)



(b)

FIG 15

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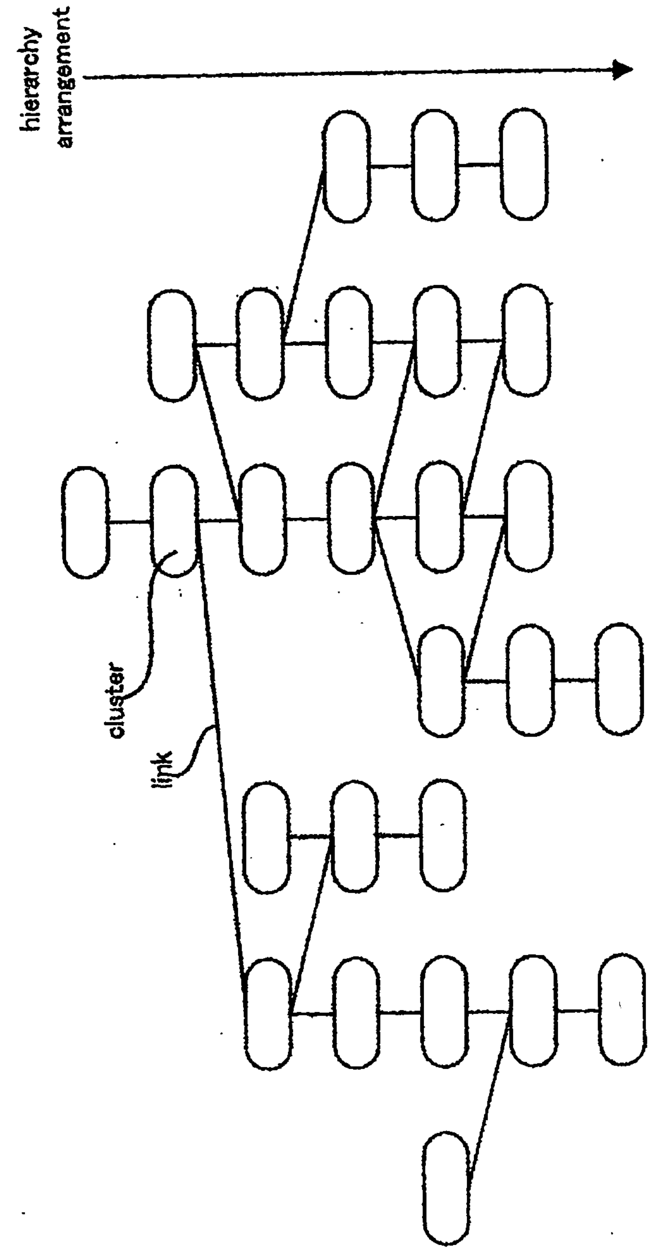


FIG 16

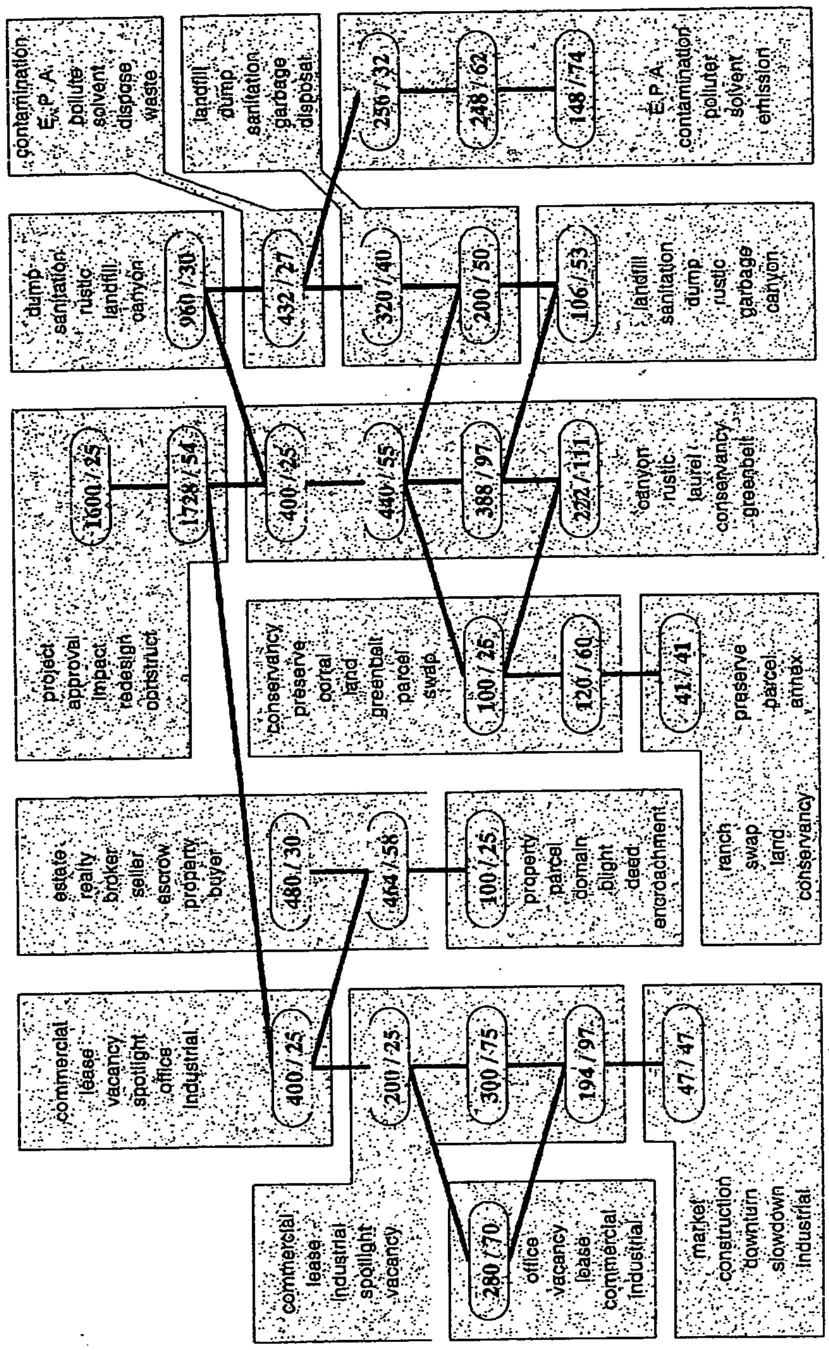

contamination E.P.A. pollute solvent dispose waste
landfill dump sanitation garbage disposal
256 / 32
248 / 62
148 / 74
E.P.A. contamination polluter solvent emission
dump sanitation rustic landfill canyon
960 / 30
432 / 27
320 / 40
200 / 50
106 / 53
landfill sanitation dump rustic garbage canyon
1600 / 25
1728 / 54
400 / 25
440 / 55
388 / 97
222 / 111
canyon rustic laurel conservancy greenbelt
project approval impact redesign obstruct
conservancy preserve corral land greenbelt parcel swale
100 / 25
120 / 60
41 / 41
preserve parcel annex
estate realty broker seller escrow property buyer
480 / 30
464 / 58
100 / 25
property parcel domain blight deed encroachment
ranch swap land conservancy
commercial lease vacancy spotlight office industrial
400 / 25
200 / 25
300 / 75
194 / 97
47 / 47
commercial lease industrial spotlight vacancy
280 / 70
office vacancy lease commercial industrial
market construction downturn slowdown industrial

FIG 17

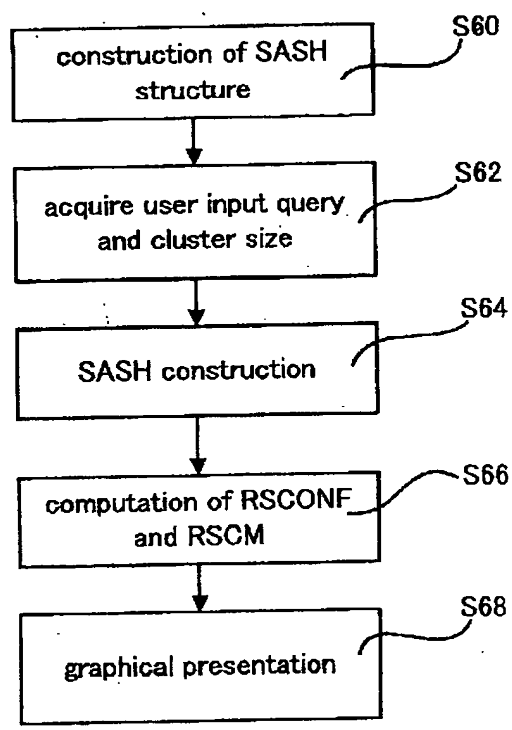
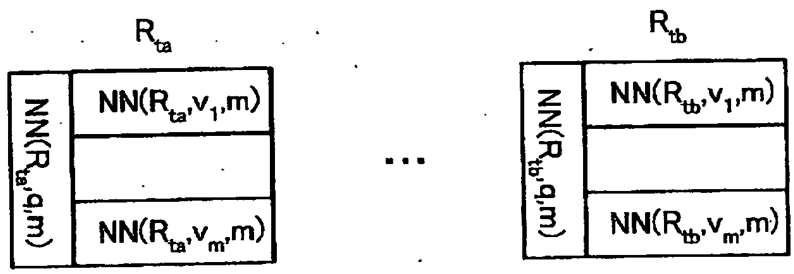
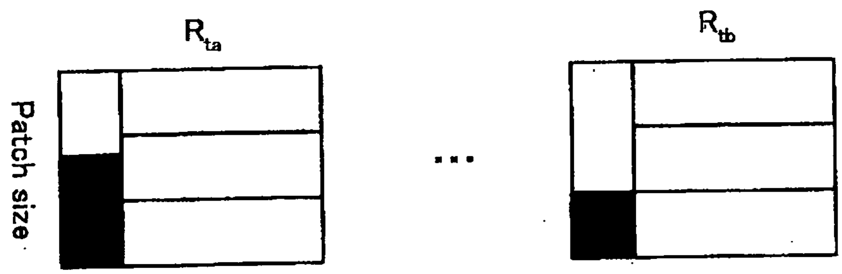

construction of SASH structure
S60
acquire user input query and cluster size
S62
SASH construction
S64
computation of RSCONF and RSCM
S66
graphical presentation
S68

FIG 18

Patches including queried nodes



(a)



0.67
RSCONF

0.39
RSCONF

(b)

FIG 19

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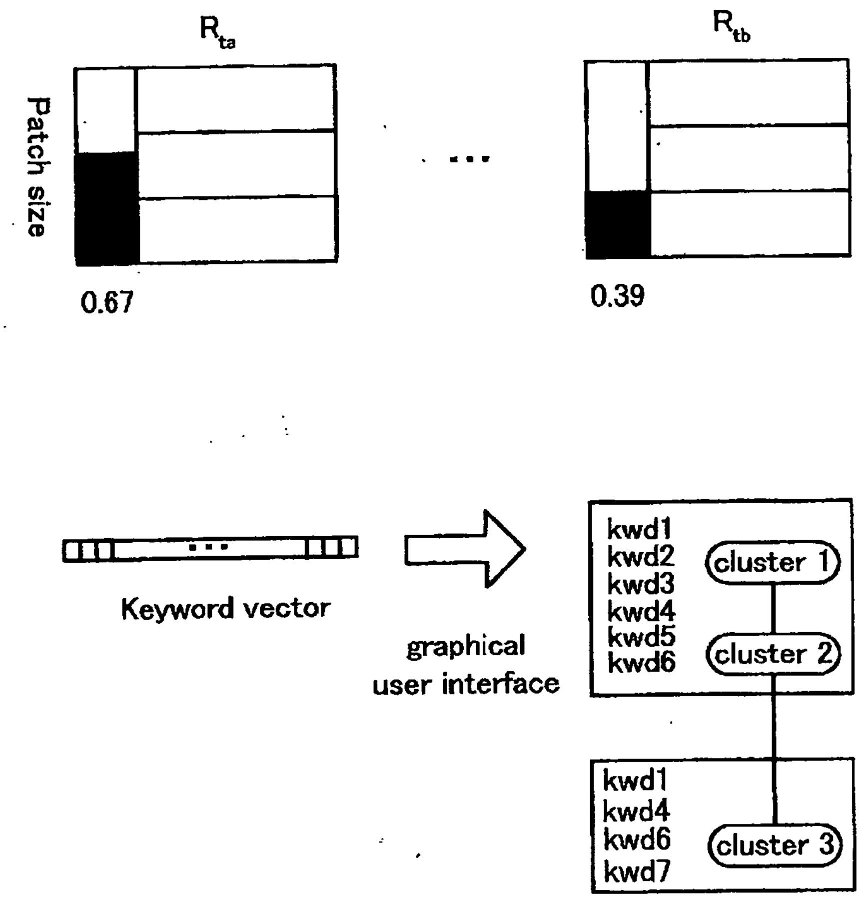
R_ta
Patch size
0.67
R_tb
0.39
Keyword vector
graphical
user interface
kwd1
kwd2
kwd3
kwd4
kwd5
kwd6
cluster 1
cluster 2
kwd1
kwd4
kwd6
kwd7
cluster 3

FIG 20

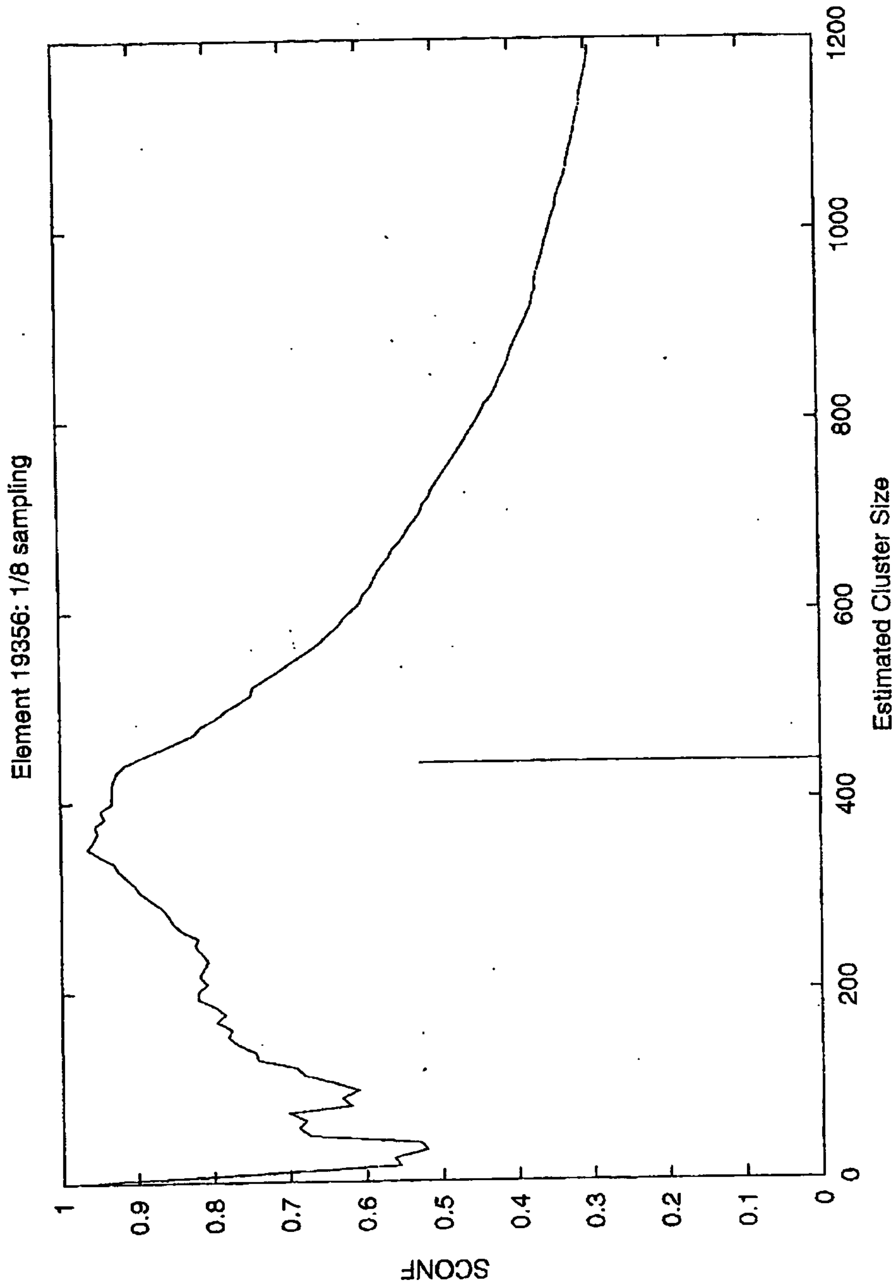

FIG 21

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